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(71) Applicant
BICC Public Limited Company

(Incorporated in the United Kingdom)

Devonshire House, Mayfair Place, London, W1X 5FH, United Kingdom

(72) Inventor
Gordon James Davidson

(74) Agent and/or Address for Service
M J Poole
BICC Public Limited Company, Patents & Licensing Department, Quantum House, Maylands Avenue, Hemel Hempstead, Hertfordshire, HP2 4SJ, United Kingdom

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(56) Documents cited
GB 1521455 A GB 1489510 A GB 1474841 A
GB 1449162 A GB 1238701 A GB 1143081 A
GB 1039633 A GB 0979746 A

(58) Field of search
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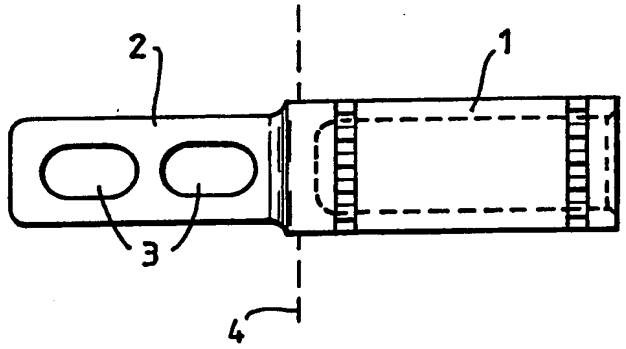
(54) Electric connectors formed of aluminium spray coated with copper

(57) A bimetallic electric connector for copper to aluminium joints is made by first forming a bulk component of aluminium (typically a stock aluminium connector) and then coating an appropriate part of its surface with copper or a conductive copper alloy (such as brass) by a thermal spray coating technique, such as plasma spraying or gas-wire metallising. The coating may be porous, in which case the use of a pore sealant e.g. an air-drying glyceride resin is recommended and this may also form a corrosion-resistant layer over the edge of the copper (or copper alloy) coating. Suitable coating and sealing techniques are commercially available. The technique is less expensive than conventional friction welding, and offers additional design flexibility. The connector illustrated in Fig. 1 comprises an aluminium tube 1 flattened at one end to form a palm 2 through which are formed holes 3, 3, the entire surface area to the left of the line 4 being coated with copper.

Fig.1.



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Electric Connectors and methods of making them

This invention relates to electrical connectors, more especially bimetal connectors for interconnecting aluminium and copper conductors, and methods of making them. Conductors of overhead lines and cables for the bulk distribution of electricity are normally made of aluminium (or a high-conductivity aluminium alloy, hereinafter included in the term "aluminium") on account of economic factors and its high conductivity per unit mass. On the other hand, internal wiring in consumers' premises normally uses copper conductors as they more easily form reliable connections, especially in small conductor sizes.

At some appropriate point, therefore, a transition has to be made from an aluminium conductor to a copper one. For this purpose bimetal connectors of appropriate geometry are used, comprising an aluminium part and a part of copper or a copper alloy (such as brass). The parts need to be secured together in a way that ensures a stable low-resistance current path between them. Mechanical connections are not considered satisfactory, because of the risk of "creep" under thermal cycling resulting in the loss of contact pressure, and bonding processes involving the use of molten metal are excluded by the risk of forming brittle, high resistance Cu/Al phases at the interface and/or by the natural oxide film on the

aluminium inhibiting contact.

Present practice is therefore to use bimetal connectors formed by solid-state friction-welding of aluminium and copper (or copper alloy) rods or tubes. This is expensive and limits design flexibility as the actual aluminium/copper interface must almost inevitably be a nominally plane surface perpendicular to the axis of the initial rods/tubes.

In accordance with the invention, an electric connector comprises a bulk component made of aluminium and a coating on a part of the bulk component made of copper or a conductive copper alloy and applied by thermal spray coating.

In most cases the bulk component can be a standard connector for aluminium conductors, and the invention includes a method of making a bimetal electric connector comprising first forming a connector of aluminium and then coating part of its surface with copper or a conductive copper alloy by thermal spray coating.

Various thermal spray coating techniques can be used, such as plasma spraying, gas-wire metallising and the proprietory technique offered under the designation "Thermospray" by Metco Limited of Chobham, Surrey GU24 8RD: (and in the USA by the Metco division of Perkin-Elmer Corp, of 1101 Prospect Avenue, Westbury NY 11590). Coatings of pure copper are preferred, but brass might be used in some cases.

If, as is normally the case, the thermal spray coating

is porous, we very much prefer to seal it by the application of a suitably penetrating high-solids liquid sealant, several of which are available and recommended for sealing thermal spray coatings used for other purposes. The sealant may also be applied as a corrosion-resisting insulating layer extending across the edge of the coating, avoiding the need for the paint banding operation normally used on conventional bimetal connectors. Excess sealant may be abraded away, if found necessary, from the contact areas of the coating.

The invention can be used to make bimetal connectors of many shapes and sizes to suit particular applications. One important style of connector comprises a tubular part for compression jointing (crimping) onto an aluminium conductor and a flat part (usually referred to as a "palm") with one or more apertures to facilitate bolting to a relatively rigid conductor or terminal of copper or brass; in this case it is preferred that the whole of the area of the palm (including the surface(s) of the hole(s), in particular) plus the transition area between the palm and the tubular part to be coated with copper or copper alloy as described. This results in the formation of a surface bimetal interface in a position where a corrosion-resisting seal (either the sealant already described or a separate band of coating, such as paint) can be easily applied and easily inspected.

The invention will be further described by way of example with reference to the accompanying drawings in

which figures 1 and 2 are mutually perpendicular view of one form of bimetal connector in accordance with the invention.

The connector comprises a length of electrical grade aluminium tube 1 flattened at one end to form a palm 2 through which are formed holes 3,3 (of circular or other suitable cross-section) for the reception of bolts. As so far described, the connector is a stock item for crimping to a circular aluminium conductor and bolting to other conductors of aluminium or compatible material. In accordance with the invention, the entire surface area of the connector to the left of the line 4 is coated with copper by plasma spraying to the "P55-10" process operated by Metco Limited. Following this operation, the copper coating is sealed by spraying with the 95% soldis air-drying glyceride resin solution sold by Metco Ltd under the designation Metco AG. This sealant is applied not only to seal pores throughout the copper coating but also to form an insulating and corrosion-resisting layer extending for at least a few millimetres on each side of the edge of the coating as a corrosion inhibitor. After standing in air for 15 minutes, excess sealant is wiped from the flat areas of the palm 2 with a clean dry cloth. It may be desirable, with this particular sealant, to allow a week's storage at ambient temperature (or an hour at 145°C) after evaporation of solvent is complete) for curing, prior to use of the connector.

CLAIMS

1. An electric connector comprising a bulk component made of aluminium and a coating on a part of the bulk component made of copper or a conductive copper alloy and applied by thermal spray coating.

2. An electric connector in accordance with Claim 1 comprising a tubular part for compression jointing onto an aluminium conductor and a flat apertured palm and in which the said coating is applied to the whole of the area of the palm.

3. A connector as claimed in Claim 1 or Claim 2 in which the coating is applied by plasma spraying.

4. A connector as claimed in Claim 1 or Claim 2 in which the coating is applied by gas-wire metallising.

5. A method of making a bimetal electric connector comprising first forming a connector of aluminium and then coating part of its surface with copper or a conductive copper alloy by thermal spray coating.

6. A method as claimed in Claim 5 in which the copper or conductive copper alloy is applied by plasma spraying.

7. A method as claimed in Claim 5 in which the copper or conductive copper alloy is applied by gas-wire metallising.

8. A connector as claimed in any one of the preceding claims in which the said coating is porous and is sealed by application of a penetrating high-solids liquid sealant.

9. A connector as claimed in claim 8 in which the sealant

also forms a corrosion resistant layer over the edge of the said coating.

10. A bimetal electric connector substantially as described with reference to the accompanying drawings.

11. A method of making a bimetal connector substantially as hereinbefore described by way of example.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number: 9202213.6

Relevant Technical fields

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(ii) Int Cl (Edition 5) C23C; H01H; H01R

Search Examiner: P G BEDDOE

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASES: WPI

Date of Search: 17.3.92

Documents considered relevant following a search in respect of claims 1-11

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
Y	GB 1521455 A (NATIONALE) see especially page 3 lines 38-53	1,3,5,6
Y	GB 1489510 A (DELTA) see especially page 2 lines 17-33	1,3-7
Y	GB 1474841 A (TELEMECANIQUE) see especially page 1 lines 76-86; Claim 1	1,3-7
Y	GB 1449162 A (WELLWORTHY) see especially page 2 lines 25-52	1,3-7
Y	GB 1238701 A (KALLE) see especially page 2 lines 42-63	1,3,5,6
Y	GB 1143081 A (ALUMINIUM) see especially Figure 1; page 2 lines 44-65	1-7
Y	GB 1039633 A (METCO) see especially page 4 lines 54-59, lines 66-75	1,3,5,6
Y	GB 979746 A (WESTINGHOUSE) see especially page 1 lines 61-76	1,3,5,6, 8,9

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Category	Identity of document and relevant passages	Relevant to claim(s)
	-8-	

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

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Fig.1.

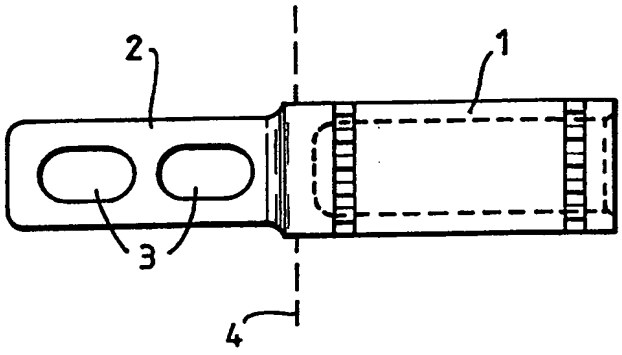

Fig.2.